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AUTHOR Hlawaty, Heide
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ABSTRACT

This study identified and compared the preferred learning-style characteristics of German adolescents and analyzed the similarities and differences by age, gender, and academic achievement within and among groups of students in different educational settings. Participants were 869 German adolescents aged 13, 15, and 17 years old from grades 7 through 13, with approximately equal representation of males and females. Students were administered the German language version of the Learning Style Inventory (R. Dunn, K. Dunn, and G. Price, 1996, 2000). Data were available about students' academic achievement, gender, and age. Results show that younger adolescents in Germany appear to be more persistent, authority-, parent-, and teacher-motivated than older students. As they mature, these students become less tactual and more in need of light. Age differences in learning-style preference indicate a shift from adult-based to self-driven motivation that should be incorporated into classroom instruction. Males and females in this population have distinctly different learning-style preferences, of which teachers and students should be aware. Of the three academic achievement levels investigated in this study, the academically gifted students were the least parent- and teacher-motivated, while low achievers favored the presence of an authority figure in their environment. (Contains 3 tables and 74 references.) (SLD)

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Heide Hlawaty

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Comparative analysis of the learning styles of German adolescents by age, gender, and academic achievement level.

Heide Hlawaty, St. John's University

Introduction

German education, with its emphasis on high scholastic performance, has been a source of interest for educators for many years (Foraker, 1999). Scholastic aptitude is the most important factor of the German education system, a system quite different from its American counterpart (Noack, 1999). In the German education system, students are grouped by academic achievement. Although several comprehensive schools exist throughout Germany, most adolescents are separated academically by the fifth grade. Therefore, a comparative study of high versus low achievers necessarily requires visitation and inclusion of same-aged students in many diverse schools. This information is of interest because *how* students learn is an important component of *what* and *how much* they learn. How students learn, or in other words, their *learning style*, can be used to identify how achievement is affected by students' learning styles. Thus, a correlational study of their learning styles is of interest.

Statement of the Problem

Students in every nation of the world learn new and difficult material in ways that are often similar and, at the same time, different from the way other students of the same age, gender, race, religion, culture and nationality prefer to learn (Dunn & Griggs, 1995). Multicultural research conducted with the Dunn and Dunn Model of Learning Styles indicated that multiple patterns of learning style exist *between* and *within* groups of students of different academic levels, ages, ethnic, racial, and socioeconomic status (Milgram, Dunn, & Price, 1993).

Well known methodologies that elicit creative thinking, use multiple intelligences, or individualize instruction based on students' learning-style preferences are mostly unfamiliar to educators around the globe despite the fact that their students' learning-style strengths significantly differ by grade level, gender, academic achievement, and creative talent areas (Honigsfeld, 2000; Pengiran-Jadid, 1998). To date, there has been no research conducted in Germany, or in other German-speaking countries, with the Dunn and Dunn model. In these countries, class instruction remains typically generalized for all students and is conducted in a conventional lecture manner. Therefore, if students are expected to learn and retain complex information to maximize their potential and become successful life-long learners in the new millennium, identification of and response to their learning-style preferences appear to be necessary (Dunn, 1990, Honigsfeld, 2000). That similarly aged and achieving youth of one nation may conceivably differ from those of other nations, apparently is of current international interest (DiSebastian, 1994; Dunn, 1989, 1993; Dunn et al., 1997; Hong, Milgram, & Perkins, 1995; Hong & Suh, 1995; Honigsfeld, 2000; Honigsfeld, 2000; Ingham, 1992, 1993; Ingham, Ponce Meza, & Price, 1998; Lam-Phoon, 1986; Lo, 1991; Milgram, Dunn, & Price, 1993; Nganwa-Bagumah & Mwamwenda, 1991; Pengiran-Jadid, 1998; Roberts, 1984; Sinatra, Sazo de Mendez, & Price, 1993; Soliman, 1993; Spiridakis, 1993, Suh & Price, 1993; Vazquez Arce, 1985, Wechsler, 1993).

Need for the Study

Brunner and Dunn (1997) reported that parents and educators share misconceptions about what constitutes effective learning. During the past three decades, research based on the Dunn and Dunn Model has revealed that six characteristics significantly discriminated between the learning styles of groups and among individuals within the same group (Dunn, 2000; *Research on the Dunn & Dunn Model of Learning Styles*, 2001). These six characteristics were (a) levels of academic achievement (Calvano, 1985; Honigsfeld, 2001; McCabe, 1992; Yong & McIntyre, 1992; Young, 1985); (b) gender (Honigsfeld, 2001; Jenkins, 1991; Lam-Phoon, 1986; Marcus, 1979; Pengiran-Jadid, 1998b; Pizzo, Dunn, & Dunn, 1990; Ponder, 1990; Zikmund, 1988); (c) age (Dunn & Griggs, 1995; Honigsfeld, 2001; Price, 1980); (d) brain processing (Cody, 1983; Dunn, Bruno, Sklar, & Beaudry, 1990; Dunn, Cavanaugh, Eberle, & Zenhausern, 1982; Guastello & Burke, 1998-1999; Honigsfeld, 2001; Tanenbaum, 1982); (e) creativity domains (Honigsfeld, 2000; Milgram, Dunn, & Price,1993; Pengiran-Jadid, 1998); and (f) culture (Brunner & Dunn, 1997; Honigsfeld, 2001; Ingham & Price, 1993; Jalali, 1988; Milgram, Dunn, & Price, 1993).

Therefore, the purpose of this study was to identify and compare the preferred learning-style characteristics of German adolescents, and to analyze the similarities and differences by age, gender, and academic achievement within and among groups of students in different educational settings.

Research Questions

The following questions were examined through this study:

(1) What is the nature and range of learning styles among 13-, 15-, and 17-year-old German adolescents?

(2) Will German male students evidence significantly different learning-style preferences from German female students?

(3) Will there be differences or similarities among the learning-style preferences of academically different achieving students?

Population and Sample

Participants for this investigation consisted of 13-, 15-, and 17-year-old German students attending 8 urban, suburban, and rural schools in the state of North Rhine-Westphalia. A total of 869 adolescents from a population of over 7, 000 students participated in this study. Students attended grades 7 through 13, depending on the school type. Males and females were represented in approximately equivalent numbers. Data were collected from two exemplars of each of the existing four secondary-school types.

Instrumentation

The German language versions of the *Learning Style Inventory* (LSI) (Dunn, Dunn, & Price, 1996, 2000) for Grades 5-12 were used to identify the learning-style preferences of the participants. This version was first translated into German (Hlawaty, 2000) and retranslated back into English by a panel of experts. The following 22 learning-style preferences are determined through the use of the LSI:

1. Noise level—The need for quiet of sound.
2. Light—The need for low or bright light.

3. Temperature—The need for cool or warm temperature.
4. Design—The need for an informal or formal learning environment.
5. Motivation—Being unmotivated versus self-motivated.
6. Persistent—Levels of persistence.
7. Responsible (Conforming) —Levels of responsibility or conformity.
8. Structure—The need for structure.
9. Alone/Peers—Learning alone versus being peer-oriented.
10. Authority Figures—The need for an authority figure to be present.
11. Several Ways—Learning through several ways.
12. Auditory—Auditory perceptual strength.
13. Visual—Visual perceptual strength.
14. Tactual—Tactual perceptual strength.
15. Kinesthetic—Kinesthetic perceptual strength.
16. Intake—The need for intake.
17. Time of day—Functioning best in the evening versus morning.
18. Late morning—Functioning best in the late morning.
19. Afternoon—Functioning best in the afternoon.
20. Mobility—The need for mobility.
21. Parent Motivated—Being parent-figure motivated.
22. Teacher Motivated—Being teacher motivated.

The LSI is a 104-item, self-report questionnaire that was developed with content and factor analysis. It measures students' perceptions of how they prefer to learn through the use of a five-point Likert-type scale and can be completed in approximately 30-40 minutes. The LSI has high reliability and face/construct validity (Kirby, 1979), and was rated as having good or better validity and reliability than nine other instruments that measure learning styles (Curry, 1987; DeBello, 1990; Tendy & Geiser, 1998-1999). Valid LSIs with consistency scores of 70 or above were received from 869 German students who occupied the final sample of this investigation. These scores indicate the overall extent of agreement between the multiple-measured question items of the LSI. Based on the LSI, scores of 817 randomly selected students in grades 5 through 12, Price and Dunn (1997) reported that 95% (21 of 22) of the reliabilities were equal to or greater than 0.60 for the Likert scale of the English version. Similarly high reliability coefficients were utilized for the German translated version.

These German students were administered an information sheet that was sent to school principals with the initial contact letter and information, and questions were answered as requested. Over a period of six weeks, the researcher personally collected the German data, in order to maintain the integrity of the LSI. These measures were undertaken, to ensure as much control of variables, as possible.

Participants were asked to report their gender and age/year of birth on the questionnaire. The sample's academic achievement level was ranked by their attendance at one of the four school types. Each student was assessed to be either gifted, high-, or average-achieving; or low-achieving.

Germany's tripartite educational system was based on the premise that students of varying academic abilities should be in separate schools in order to

reach their highest potential (Foraker, 1999). Because the curriculum, standards of performance, and academic orientation of instruction in the *Gymnasium* are meant to challenge the best and brightest, these students represented the gifted population. Students of the *Realschule* were of moderate academic ability and were considered average/high achievers. At the lower secondary level, the *Hauptschule* was organized for students who were least academically able, with these learners categorized as the low achievers. The level of social status and respect accorded to German teachers varied with the type and location of school at which they taught, with teachers reporting a status hierarchy among their peers at different types of schools. For example, *Gymnasium* teachers tended to be held in much higher esteem than other teachers. *Realschule* and *Gesamtschule* teachers had less status, and *Hauptschule* teachers had the lowest status of all teachers. Although the *Gesamtschule* included students of all abilities, it was an unspoken assumption that most parents sent their gifted children to *Gymnasium*, rather than *Gesamtschule*, thereby increasing the possibility that these individuals would demonstrate their gifted caliber (*National Institute on Student Achievement, Curriculum, and Assessment*, 1999).

Data Analysis Procedures

Scaled scores for the 22 learning-style elements were examined, as measured by the *Learning Style Inventory* (LSI) (Dunn, Dunn, & Price, 1996, 2000). Means and standard deviations were calculated for the descriptive statistics. Inferential statistics were established by univariate analyses of variance (ANOVAs), *t* tests, and multivariate analyses of variance (MANOVAs).

In the case of a three-level dependent variable (age and academic achievement level), Type I error was controlled through the utilization of the extended-Fisher procedure for multiple comparisons (Levin, Serlin, & Seaman, 1994). Significant omnibus one-way multivariate analyses of variance (MANOVA) ($\alpha = 0.05$) were further followed by level-specific pairwise multivariate analyses of variance (MANOVA) at $\alpha = 0.05$. Subsequent post-hoc tests were conducted with a Bonferroni adjustment of $\alpha = 0.002$. Tamahane's T2 tests of unequal variance were performed for learning-style variables that revealed significant differences of variance through Levene's test for homogeneity of variance. In the case of homogeneous variances, the Tamahane's T2 procedure is approximately equal to Fisher's LSD. When the dependent variable contained more than three levels, Dunnett-*C* post-hoc tests for multiple comparisons, with a Bonferroni adjustment to $\alpha = 0.002$, were utilized.

Eta-squares (η^2) were reported as effect sizes to determine the magnitude of the results regardless of sample size. As suggested by Huberty and Lowman (2000), effect sizes should be reported for group mean comparisons involving multilevel grouping variables, such as the three-level age variable, two-level gender variable and three-level achievement variable. An $0.15 < \eta^2$ was reported as a large effect size, $0.01 < \eta^2 > 0.09$ as a medium effect size, and $\eta^2 < 0.01$ as a small effect size (Cohen, 1988).

Results

Age. Utilizing the extended-Fisher application for multiple comparisons, as described by Levin, Serlin, & Seaman (1994), an omnibus one-way multivariate analysis of variance (MANOVA) was conducted to determine the effect of the three levels of age on the 22 dependent learning-style elements, regardless of gender or academic achievement level. The results of this procedure illustrated significant differences among the three age groups, Wilks' $\Lambda = 0.71$, F (44, 1690) = 7.16, $p < 0.001$.

Follow-up level-specific MANOVA revealed significant differences among all three pairwise comparisons of age groups:

(1) 13- vs. 15-year-olds, Wilks' $\Lambda = 0.86$, F (22, 675) = 4.83, $p < 0.001$;
(2) 13- vs. 17-year-olds, Wilks' $\Lambda = 0.62$, F (22, 493) = 13.56, $p < 0.001$; and
(3) 15- vs. 17-year-olds, Wilks' $\Lambda = 0.80$, F (22, 501) = 5.53, $p < 0.001$.

Adjusted via a Bonferroni correction, Tamahane's T2 post-hoc comparisons were conducted to evaluate differences among the dependent learning-style variables on the three age levels, revealing significant F values for 9 of the 22 elements (light, temperature, persistence, authority-figure present, tactual perceptual strength, intake, afternoon, parent-motivated, and teacher-motivated); each pairwise comparison was tested at the 0.002 level.

The strength of association between age and the learning-style variables, as assessed by η^2 ranged from small to medium effect size. The learning-style elements of temperature, persistence, tactual perceptual preference, and afternoon had small effect sizes ($\eta^2 < 0.01$), whereas the elements of light, authority-figure, parent-motivated, and teacher-motivated had medium effect sizes ($0.01 < \eta^2 > 0.09$).

Gender. A series of independent-samples t-tests were conducted to assess the hypothesis that German male and female students would have significantly different learning-style preferences regardless of age and academic achievement. Utilizing a Bonferroni adjustment to amend the level of significance ($\alpha = 0.002$), the t-tests for equality of means revealed significant differences for 5 of the 22 learning-style elements (light, motivation, responsibility, learning in several ways, and intake) at the $p < 0.002$, $p < 0.001$, and $p < 0.0001$. The effect size of the relationship between gender and the learning-style elements, as measured by η^2, was small ($\eta^2 > 0.01$) for light and intake, and medium in scope ($0.01 < \eta^2 > 0.09$) for motivation, responsibility, and learning in several ways.

Academic achievement. An omnibus one-way multivariate analysis of variance (MANOVA) was conducted to determine the effect of the three levels of achievement on the 22 dependent learning-style elements, regardless of age or gender. Significant differences were found among the three achievement groups, Wilks' $\Lambda = 0.81$, F (44, 1690) = 4.15, $p < 0.001$.

Follow-up level-specific MANOVA revealed significant differences among all three pairwise combinations of achievement groups:

(1) gifted- vs. low achievers , Wilks' $\Lambda = 0.78$, F (22, 404) = 5.16, $p < 0.001$;
(2) gifted- vs. high/average achievers, Wilks' $\Lambda = 0.89$, F (22, 721) = 4.06, $p < 0.001$; and
(3) high/average- vs. low achievers, Wilks' $\Lambda = 0.89$, F (22, 544) = 3.06, $p < 0.001$.

Adjusted via a Bonferroni correction, Tamahane's T2 post-hoc comparisons were conducted to evaluate differences among the dependent learning-style variables on the three achievement levels, revealing significant *F* values for 4 of the 22 elements (authority-figure present, mobility, parent-motivated, and teacher-motivated); each pairwise comparison was tested at the 0.002 level. The strength of association between age and the learning-style variables, as assessed by η^2, had a medium effect size ($0.01 < \eta^2 > 0.09$).

Discussion

Age. The results of this investigation indicated that 9 of the 22 elements--light, temperature, persistence, authority-figure present, tactual perceptual strength, intake, afternoon, parent-motivated, and teacher-motivated--significantly discriminated among the three age groups, graphically displayed in Table 1. The learning-style elements of temperature, persistence, tactual perceptual preference, and afternoon had small effect sizes, whereas the elements of light, authority-figure, parent-motivated, and teacher-motivated had medium effect sizes.

Many of these findings were reflected in previous research results. Similar to Price's (1980) and Honigsfeld's (2001) investigation, older German students in the current study needed more light and were less adult-motivated than younger participants. Conversely, younger students were more tactual than older adolescents. As originally found by Dunn and Griggs (1995), time-of-day preferences were evidenced by the afternoon proclivity of this German sample.

Table 1

Summary of Significant Age Differences in Learning Styles of German Adolescents

	AGE		
ELEMENTS	13-YEAR-OLDS	15-YEAR-OLDS	17-YEAR-OLDS
Light			✱
Warmth		▲	▲
Persistent	■		
Authority-Figure	✱		
Tactual Perceptual Strength	■		
Intake			▲
Afternoon	■		
Parent-Motivation	■		
Teacher-Motivation	■	■	

Note. ✱-most preference than other age groups
▲-more than 13-year-olds
⌘-more than 15-year-olds
■-more than 17-year-olds

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Corroborated by these current findings, Nganwa-Bagumah and Mwandwenda (1991) reported perceptual-preference changes similar to those described by Jorge (1990) and Dunn (1997) regarding younger students' predilections for tactually- and kinesthetically-based learning. Honigsfeld (2001) reported that persistence was consistently discriminated among the three age groups of 13-, 15-, and 17-year old adolescents. She found that younger learners were more inclined to achieve better with tactual and kinesthetic instructional approaches, whereas older students performed more positively with visual- and auditory-based methodologies, with an accompanying informal learning environment. The decrease in persistence among the oldest group also confirmed Dunn's (1985) results.

This sample of older students evidenced a preference for robust lighting, a trait commonly associated with Analytic Processors. Dunn and Griggs (1995) postulated that the older adolescents became, or the longer they stayed in school, the more they tended to become Analytic Processors. Another plausible explanation was the nature of the German education system. According to policy, 17-year-old students were precluded from the lower-achievement *Hauptschule* and average-achievement *Realschule*. The assumption that youngsters who attended these school types were underachievers and possessed Global-Processing styles explained why the majority of 17-year-olds in this study preferred a brightly lit learning environment (Honigsfeld, 2001).

Because of the wide range of psychological, physiological, and emotional changes that German adolescents experience as they develop, certain profiles of learning-style characteristics may be expected in most classrooms in the German republic. Younger adolescents appear to be more persistent, authority-, parent-, and teacher-motivated than older students. As they mature, these students become less tactual and more in need of light. Age differences in learning-style preference indicate a shift from adult-based to self-driven motivation, which, if not already in place, should be incorporated into classroom instruction. These trends were reported earlier by Dunn and Griggs (1995) for American adolescents.

Gender. Diverse and significant gender variables were revealed through *t*-tests for 5 of the 22 learning-style elements--light, motivation, responsibility, learning in several ways, and intake. Results were graphically depicted in Table 2. The effect size of the relationship between gender and the learning-style elements was small for light and intake, but medium in scope for motivation, responsibility, and learning in several ways.

Findings specific to self-motivation and persistence were consistent with previous investigations by Hong and Suh (1995), Honigsfeld (2001), Jenkins (1991), Lo (1994), Mariash (1983), and Pengiran-Jadid (1998). Results related to females' preferences for sociological variety supported Jorge's (1990) and Lam-Phoon's (1986) conclusions. Females preferring intake over males was an unexpected outcome and did not corroborate with the results of previous studies (Lam-Phoon, 1986; Yong, 1992).

German males and females have distinctly different learning-style preferences, of which teachers and parents should be aware. These adults need to become more cognizant of females' self-motivation and sense of responsibility

(conformity), and the importance these traits play in adolescent females' own sense of confidence and control. Since German females also preferred to learn with more sociological variety than males, they need more options regarding educational scenarios, including working independently, in pairs, with peers, in larger groups, and with teachers. Gender differences in learning style were reported in several previous studies (Hong & Suh, 1995; Honigsfeld, 2001; Jenkins, 1991; Lam-Phoon, 1986; Marcus, 1979; Mariash, 1983; Pengiran-Jadid, 1998).

Table 2
Summary of Significant Gender Differences in Learning Styles of German Adolescents

ELEMENT	GENDER	
	MALE	FEMALE
Light		✓
Self-Motivation		✓
Responsibility		✓
Sociological Variety		✓
Intake		✓

Note. ✓ denotes greater preference for element than other gender

Academic achievement. Regardless of age and gender, German adolescents revealed significant differences among the achievement groups for 5 of the 22 learning-style elements--structure, authority-figure present, mobility, and being parent- and teacher-motivated--among the three achievement levels, graphically described in Table 3. The strength of association between achievement and the learning-style variables had a medium effect size.

Of the three achievement levels investigated in this study, the academically-gifted students were the least parent- and teacher-motivated, consistent with previous findings by Griggs and Price (1980, 1982), but not with McCabe's (1992), Nations-Miller's (1993), and Yong and McIntyre's (1992) research. Gifted learners also evidenced less need for mobility than high-, average-, or low-achievers, which corroborated prior results (Calvano, 1985; McCabe, 1992; Nations-Miller, 1993), but contrasted other findings (Gallucci, 1991). As determined by previous conclusions (Calvano, 1985; Lo, 1994; Milgram & Price, 1993; Pengiran-Jadid, 1998; Suh & Price, 1993), low achievers favored the presence of an authority figure in their environment while studying, as well as patterns and routines.

Differences in motivation toward parents and teachers may have been influenced by many factors, such as peer- and parental-support and the perceived connection between success at school and future employment. The impact of these aspects on academic achievement and vocational opportunities conceivably might have acted as the driving force behind students' motivation (Foraker, 1999; Milotich, 1999). Gifted achievers attending *Gymnasium* delayed

career decisions until later in adolescence, although the majority of *Gymnasium* students planned to take the *Abitur* to qualify for study at a university or professional level school. By having a clear and focused future goal, low- and average-achievers may have been more motivated by those individuals who assisted them in reaching those objectives, namely parents and teachers. In addition, both *Hauptschule* and *Realschule* teachers were permitted to include a grade for class participation, especially for students who were in academic jeopardy. Class participation was included as part of students' grades at the *Gymnasium*, but marks were more stringently calculated there than at the other schools.

Table 3
Summary of Significant Academic Achievement Differences in Learning Styles of German Adolescents

	ACADEMIC ACHIEVEMENT		
ELEMENTS	GIFTED	HIGH AND AVERAGE	LOW
Structure			✖
Authority-Figure			◆
Mobility	✖		
Parent-Motivation	✖		✖
Teacher-Motivation	✖		▣

Note. ▣-most preference than other achievement groups
✖-more than gifted achievers
◆-more than high/average achievers
▼-more than low achievers

Because parent- and teacher-motivation were more prevalent in the current sample's low-, average-, and high-achieving students, the academically gifted youngsters' profiles resulted in a smaller percentage of adult motivation, indicating these young adults' relative maturity and independence. Emerging as a new trend, students currently are being permitted to work as of 16 years-of-age. Because they may be employed, school and its emphasis on scholastic ability may have lost its appeal in light of potential monetary prosperity. Many gifted youngsters no longer place importance on pleasing their parents and teachers, since they view employment as an alternative route to embarking on a course of study at the university level (C. Denis, personal communication, August 5, 2001).

German academically-gifted students' levels of low parent- and teacher-motivation may have indicated their sense of self-enhanced learning. Educators should consider an individual, student-centered, or peer approach that capitalizes on these adolescents' characteristics. External rewards may not affect these learners' performance and should not be used as an incentive for academic achievement. Perhaps these gifted students should experience increased control over their educational program, such as would be provided by Contract Activity

Packages (Dunn & Dunn, 1993). Educators may consider utilizing German low-achievers' sense of parent- and teacher-motivation to form a professional rapport with these students to assist them to improve their academic performance.

Educational Importance of the Study

Knowledge is Power Francis Bacon

Germany has become an emergent emigrant nation, reflecting a cultural and social diversification not seen before (*Statistisches Bundesamt Deutschland*, 2001). This research has contributed to the ever-growing knowledge base of individuals' learning-style characteristics. By adding to this base, we augment the prospect of a globally unified understanding of how students learn and how to teach them. It is within our power to utilize this knowledge of students' learning styles and to assist them to maximize their potential.

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